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ABSTRACT

Since technology is a function within and a dominant part of the human equation, it is important to develop theories of social institutions and change consistent with the present electronic revolution, in order to avoid becoming "tools of our tools." Our intellectual and technological evolutionary process must change to accommodate the shift from concrete and finite resources to the abstract and infinite notions of resources characteristic of the "information age." The need for a social paradigm shift is evident when we observe the world economic and political interaction, the world-wide phenomena of structural unemployment, the position of knowledge as the major source of capital in our economy, and the social dislocation resulting when levels of moral and intellectual literacy are inadequate. Although knowledge and wisdom should have higher priority in an information society, educational programs emphasize information. The knowledge of the most social worth will eradicate areas of ignorance that are the most dangerous to human life and spirit, including arrogance, lack of a noble and ethical conception of self and community, and loneliness. In conclusion, current educational priorities must be re-evaluated, and instructional patterns that can best bring discipline, love, learning, and vision into the curriculum at all grade levels must be instituted. (LH)

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SCIENCE, TECHNOLOGY AND THE HUMAN EQUATION:
DEVELOPING A NEW PARADIGM FOR EDUCATION

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May, 1983

J. Bronowski

SCIENCE, TECHNOLOGY AND THE HUMAN EQUATION:
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E.E. Cummings in one of his last lectures at Harvard University stated: "There's a hell-of-a-good universe next door, let's go".^{*}

Cummings' distrust and disdain for science and technology had come to such a focus that his "solution" was to leave. We have made a mess, so we ought to move. This attitude is an example of what I call "frontieritis." That is, kick-out the campfire and move further west. And, now, according to Cummings, we can move from this world altogether. However, the fact of the matter is that there is no place to go. This is the universe and this is the planet in which and upon which we are fixed. Like it or not this is home. As we think about technology and the human condition, there are two spiritual dangers in not contemplating the concept of this earth as our home. The first is to assume that you can actually leave your home and your heritage. The second danger is to think that we can separate the tools which we use from our thoughts about family and culture. It is this last spiritual danger that I would like to address here.

568/10/85
Tools are thoughts and thoughts are tools. As a pre-requisite to any discussion about technology and the human condition, it must be clear that technology is as much a thought as a thing. It is a way of thinking, a way of doing, and a way of feeling. Technology is a function within the human equation. In fact, today

* Quoted in Magic, Science and Civilization by J. Bronowski, Bampton Lecturers No. 20, Delivered at Columbia University, New York, 1978.

it is a dominant part of that equation. And because of this fact, technology can destroy and/or enrich beyond anything which the human family has ever known.

Another truism . . . "technology is a human creation" . . . and as such, it is as a child (a son or a daughter) who is at once a part of us and a legacy beyond. Technology is a human extension in very important ways. It extends our physical and mental powers, and, like our children, it extends our impact far into the future. In a sense, technology makes us immortal, but it also can destroy the earth and all life upon it. If this sounds like technology has the power of a god, it may, indeed, be seen and felt as such by many today. From the car to the computer, the human behavior of worship can be observed in describing relationships between people and their tools.

As a species, our greatest need today is to create new possibilities for using our tools. New possibilities that can help us nurture our home and our human condition. Our intellectual and technological evolutionary process must begin to move in a new direction. Writing in the Third Wave, Alvin Toffler discusses the fact that we are entering a "new time"; a time dominated by information and electronics. I would like to ride the analogy of the Third Wave and focus our attention on the interrelatedness of society and technology and the implications of this new reality to our school programs. This new reality, which some call (The Information Age), must be understood as a basic shift from concrete to abstract notions of "resources," and as a new way of viewing the social world.

Thinking of information as an abstract resource is, indeed, a new notion. It's analogous to the change in thinking that took place when the scientific world moved from Newtonian to modern physics earlier this century. Galileo, Bacon, and Newton developed the idea that matter and mind were different concepts and that nature worked according to observable mechanical laws. Newton, in Principia, said, "I am only going to make one central hypothesis and that's that the center of the world is fixed". An almost comfortable idea, right? But this hypothesis came to an end in 1905 when Einstein proposed relativity. As an example, Newton's law on gravitation asserts that the gravitational force between two bodies (masses) falls off (decreases) as the inverse square of the distance. And, the law works quite well when applied to our solar system or long range forces. But, it has little applicability and even seems simple minded when applied to sub-atomic structures. Indeed, the short range forces between the electron and nucleus resemble only slightly the forces between the larger bodies of our solar system. To a large degree we have left observation behind and have moved to the abstract world of probability . . . to the marriage of matter and mind. In the natural world this force is an abstract resource (a thought) not unlike the "force of information" which is an abstract resource (also a thought) in the social world. There is, however, a most significant difference between the notion of resource as concrete as opposed to abstract. Concrete resources tend to be finite while abstract resources are infinite. This fact has serious implications for our economic concept of scarcity. While we have come to believe that the concrete factors of production (i.e., land, labor and capital) are more or less fixed, the reality of the information/electronic revolution has rendered this notion as obsolete as applying Newtonian physics to the workings of atoms. In other words, a social paradigm shift is needed, not unlike the shift from

Newtonian to modern physics. We need to pull social thinking out of the 19th Century; we need to develop theories of social institutions and change consistent with the present information/electronic revolution; while at the same time, knowing that our cultural heritage holds the only key to the future.

To better establish the need for a social paradigm shift, let us look at a few things that are going on in our world today:

A. WORLD ECONOMIC/POLITICAL INTERACTIONS

While the nations are still living in the distant past of primitive armor clamoring; multi-national corporations are treating the globe as a world supermarket. The corporations argue that labor is labor be it Malaysian or Michigan. Yet they, like all of us, want the protection of our constitutional system. The human family seems to lack the will and knowledge to work at peace. Our ethical systems have become so fragmented that we have embraced the cold wind of loneliness. Without ethics, being alone is the normal state of affairs, no matter how crowded our planet becomes. And it is loneliness as much as greed that will destroy us. We desperately need new social theories that can suggest consistency among economic, political, and ethical concepts.

B. STRUCTURAL UNEMPLOYMENT

It is a fact patent both to the unemployed and under-employed that the economy has left politicians, economists, and educators somewhere in the distant past. We continue to look for

economic principles that were used in the pre-1970s and the result is structural unemployment rates approaching 25% of the labor force. And, this is a world-wide phenomenon. It would seem that no one, again, has the will or knowledge to move into the present. Today, approximately 50% of our U.S. workforce is in the information business; while 4% are engaged in agriculture and 17% in manufacturing. Agriculture and manufacturing will either stay at their present levels or actually decline. In fact, manufacturing will probably continue its decline as corporations produce more and more goods in third world countries. The 25% who are unemployed and the 4% involved in other work (particularly cottage industries) will not find work in traditional manufacturing or agriculture. Today, a strong body is no longer sufficient for employment.

C. KNOWLEDGE AS CAPITAL

Knowledge has become the capital of today. Knowledge has always been related to power, but now it has also become the center of our economy; the crucial resource. This, of course, is not a physical resource, but an abstract, infinite one. We must, however, develop a way to use or interject knowledge into our economic, political, and social systems in much the same way that fossil fuel was interjected in the economies of the late 19th Century and first three quarters of the 20th century. As our economy became energy intensive with the industrial age, today it must become knowledge (and wisdom) intensive.

D. SOCIAL DISLOCATIONS

Governments, families, churches, schools and virtually all institutions are suffering from a sense of inadequacy and illiteracy. The levels of moral and intellectual literacy are simply inadequate to the issues which need to be addressed today. And, so the institutions stumble into the future trampling individuals in their path.

If we reflect upon these four items it becomes increasingly clear that we need to focus attention on the best of our cultural heritage and the construction of new social theories, so that we can prepare citizens who can ride the third wave with skill and grace. But, prior to any discussion about school programs let us take a closer look at "information"; the name given to this new age.

Perhaps, we might start with T. S. Elliott's ideas on information which were stated in "The Rock".

Where is the knowledge we have lost in information?

Where is the wisdom we have lost in knowledge?

There is a significant difference among notions of information, knowledge, and wisdom. Information is a one-dimensional phenomenon. It is linear or horizontal, fragmented and quite useless in and of itself. Knowledge is structured information that shows relationships between and among bits of information. Knowledge is best represented in theories about natural and social phenomena. Knowledge is basically created within content areas and tends to be field specific. Wisdom is the organic use of information and knowledge applied to

human dilemmas and dreams. Wisdom is that quality of thought and imagination that ties us to the cultural heritage and gives us the ability to find and build the moral fabric upon which human life is defined and meaning resides. The patterns of life are found in this fabric and they should be manifested in the motive concepts of our culture; concepts such as justice, love, courage, and beauty. The fact that information, knowledge, and wisdom are different constructs and different ways of knowing has direct implications for education. First of all, it is critical to have students involved with all three levels of thinking and knowing, so that our tools (and thoughts) can be tempered with wisdom as well as with knowledge. This is particularly important today, since we have reached a point in history where our tools ("technology") can actually turn out information. In other words, we have tools that are performing a very human function . . . passing on information. Second, we should understand that wisdom is more important than knowledge and knowledge more important than information. While all are needed within an "information society", the areas of knowing which are most needed and most useful are knowledge and wisdom. Information, in an information age, by definition, is everywhere abundant. This is not so with knowledge and it's even less the case with wisdom. Yet, the latter two constructs are necessary if the new information age is to be sensitive to making the human condition better. This is the central issue, the central function in the human equation which deals with technology. Yet, in our education programs we tend to place most emphasis and spend most of our resources on information. Why is this the case? Perhaps, it is so because teaching information is easier than teaching knowledge and wisdom. Information is also easier to test and to write textbooks for. Also, the teaching of knowledge and wisdom calls for school programs that are coordinated and for teachers and administrators who behave as members of a community of scholars.

We are faced, then, with a new age and new technologies which provide students with information in many ways and from many sources. However, the question here at issue is whether or not the schools can re-define their present emphasis away from information and toward knowledge and wisdom. The information age may well call for a new view of education . . . a view that will place attention on content unity and meaning; and on behavior which emphasizes reasoning and responsibility.

Given the nature of the problems faced by the human race today, and the fact of the information age, it would seem that some changes are necessary in the way in which educators approach the question of, "what knowledge is of most social worth?" All of us (students and educators) should start constructing answers to this question. This is the important educational task of this decade.

The knowledge of most social worth (including technological knowledge) is basically that knowledge which can best destroy those areas of ignorance most dangerous to human life and spirit. As notions to worry about we might suggest the following:

* ARROGANCE

Perhaps Solomon was right when he said that, "the fear of the Lord is the beginning of wisdom." Or consider the problem of arrogance relative to the ship, Titanic. The Titanic was not destroyed by an iceberg but by arrogance. Information and knowledge can fool people into believing they are all powerful. This arrogance can, of course, lead to the destruction of the species. Power must be tempered with wisdom.

* A LACK OF A NOBLE AND ETHICAL CONCEPTION OF SELF AND COMMUNITY

One of the most dangerous areas of ignorance is manifested when an individual or people lack a vision of noble possibilities. Things are never as good, nor as bad as they can be. We must, however, hold to the belief that we can make things better. Tell all who will listen that we can yet build a better condition . . . a better society . . . a better person. And, if we achieve this better condition even for "one brief shining moment," it will be worth the effort. For without attention to nobility, justice, and liberty, the human future is dim indeed. Again, the weapons to combat this ignorance are found in the wisdom of the human family, and not in information.

* LONELINESS

It seems to be the case that more and more information tends to make human beings more alone. The home becomes an "electronic cottage" linked to the world yet in touch with no community. Church becomes a "media experience" devoid of personal caring and love. We actually have individuals today who are preparing for a nuclear or economic holocaust and they are providing for their future "safety" by isolating themselves from the community. It may well be that unless the energies that are spent on driving people apart can be reinvested in developing new and better conceptions of community; people and the ideals for which they have lived and died will be forever lost.

The significant ideas and ideals that can address these three dangerous areas of ignorance can be best stated in the following concepts: discipline, love, learning, and vision. And so the questions for educators are, "what should be taught to students so that they may develop a mind and spirit capable of more discipline, more love, more learning, and more vision?" "And how should this teaching/learning take place?"

Or, put another way, "Can we teach Wisdom?"

I seriously believe that it can be taught. It's here in our cultural heritage just waiting to be used. And so, educators will have to come to grips with the following questions:

1. What content will help us teach discipline, love, love of learning, and vision (perspective)?
2. What types of instructional patterns will best address these ideas?

That content which can help develop wisdom is found basically in those disciplines and discipline combinations that find little attention in our present school programs. Content areas so slighted include the study of philosophy (and ethics); economic/social institutions; history and literature; and aesthetics and science. But these content areas will continue to be slighted until we can rid ourselves of some of the junk food curriculum that we are now "feeding" our children. This is the situation simply because of the opportunity costs or tradeoffs involved in curricular decisions. Specifically, we must be willing to re-evaluate current

practices such as:

*Time and Resources Spent on Reading Programs

Studies are beginning to show an inverse relationship between the amount of money and time spent on reading classes and reading comprehension scores.

(See Appendix A)

*Time and Resources Spent on Career Studies

In many courses which attempt to deal with career studies, students are asked to make a tradeoff between the study of wisdom and the study of immediate career goals. This type of emphasis can only lead, in the long run, to personal disillusionment and citizens who are unprepared for the economic changes ahead.

As Lincoln said in his Second Annual Message to Congress on December 1, 1862: "We cannot escape history." But he also stated that, "the dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so must we think anew and act anew. We must disenthrall ourselves, and then we shall save our country."

We, too, must rethink the content now being presented to our students. Instructional patterns that can best bring discipline, love, learning, and vision to students must be constructed. In essence, we must separate ourselves from the "conventional wisdom" of pedagogy. To begin a curriculum reconstruction we might consider the following framework:

K-3

Within the K-3 program, priorities should be given to areas such as: social contract and civic responsibility, health (including some attention to the Non-Combative Martial Arts); literature . . .

stories from the cultural heritage which emphasize moral principles; creative dramatics; art and music; and languages (particularly second language learning).

4-10

From grade 4 through grade 10 the curriculum should place emphasis upon the traditional disciplines, i.e., math, the social studies, science, etc. Attention within these disciplines should be placed upon reasoning, problem-solving, and creative thinking.

11-12

In the last two years of secondary school, priority should be given to discipline combinations such as: social mathematics (statistics, probability, and computer sciences applied to social phenomena); science and society, technology and ethics; economic change and work/life styles; aesthetics and the environment; etc.

The movement toward these ideas will not come about from any state or even local mandate. What is needed, more than anything else, is a commitment on the part of educators, parents, and students to build discipline and love; learning and vision into all educational endeavors. This must be an evolutionary process led by individuals and groups who themselves manifest the qualities of discipline and love; of learning and vision.

Technology can help in this endeavor, if, and only if, we understand that tools and technique are only variables within the human equation. Thoreau warned us

that we run the risk of becoming the "tools of our tools." In many ways, we have already become tools of our tools, but our educational system can, I believe, turn this situation around so that we can use these tools and techniques to enhance the human mind and the spirit.

I wish I could catch the wind,
and fly it to your side.
But, I'm on the road again,
going nowhere.
Locked in technique,
and keeping to the plan,
I'm out of touch with myself.
One would think I would know by now,
that meaning is not to be found in tools,
So much as in the light of wisdom.
Which illuminates our path,
With grace . . .
With beauty . . .
And with justice.

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APPENDIX A

LESS TIME TEACHING THEM TO READ

William Raspberry
In San Francisco Examiner
December 5, 1981

The reason our children are such poor readers is that we spend too much time teaching them to read.

That, at least, is the intriguing conclusion of an educator who has spent a lot of time looking at the problem of reading in the nation's public schools.

The real problem is not the thing we normally think of when we talk about reading: learning to pronounce words and to understand their meanings. The problem is in reading comprehension: teaching children to think about what they read.

"National test scores show that American schools have been making steady progress in teaching young children the fundamentals of reading," Richard C. Anderson, director of the University of Illinois Center for the Study of Reading. "However, scores are still poor in the middle and upper grades where more complex reading and thinking skills are required."

"We are now quite sure we know some fundamental reasons for poor performance. Careful analysis of reading programs has revealed that children are not being given enough help in learning to think about what they read." Too much classroom time is spent on workbook exercises that are irrelevant to the goal of reading with comprehension, he said.

Unfortunately, says Anderson, many teachers go right on teaching the basic word-attack skills, even after the children have a reasonably good grasp of them, and the result is that they often lose interest in reading.

He cited a study of 14 Illinois school districts that found only 45 minutes - out of 11,587 minutes of class time - were spent on direct instruction that went beyond the pronunciation of meaning of individual words. Up to 35 percent of classroom reading time is spent filling in blanks in workbooks, he said. Poor readers - even when they can pronounce most of the words - "do not link what they are reading with what they already know."

What works best, Anderson has found, is to spend as little time as possible on decoding, moving the children quickly on to material that is interesting, even if it involves new words.

Anderson's seemingly paradoxical thesis may turn out to be altogether reasonable: The way to improve our children's reading is to spend a lot less time teaching them to read.